Weather or Not?

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Super Soggy December

by Dave Bruno

Thanks in large part to a huge upper level low pressure system that brought rain to the region from the 17th through the 22nd, December 2010 will go down in the record books as one of the wettest, and in many cases the wettest, Decembers in history across southwestern California. Most of southwestern California received between 3 and 6 times the normal rainfall for the month, or 300 to 600 percent of normal.

The first few days in December 2010 were generally mild and dry across the region. A storm system moved into central California on the 5th. Its associated front brought rain to the region on the 5th into the early morning hours of the 6th. Rainfall totals generally averaged one third of an inch to three quarters of an inch across the region. Gusty south winds affected the mountains, with wind gusts of 40 to 50 mph common from the afternoon of the 5th through the early morning hours on the 6th.

Dry weather returned on the 6th and continued through the middle of the month.

A dramatic change in the weather pattern began after the 16th. A large upper level low pressure system moved into the northeastern Pacific, well off the coast of the Pacific Northwest on the 17th, then lingered there through the 21st. The circulation around the southern side of this upper low pushed very moist air with a subtropical connection into the region. This ribbon of moisture remained focused across southern California from the 17th through the 21st, bringing almost continuous rain to the region during that time. Several impulses rippling through the moist subtropical flow caused periods of heavy rain at times. On the 21st, the upper low began to shift eastward. Its associated strong frontal system moved across southwestern California late on the 21st through the 22nd, putting an exclamation point on what was a very wet week.

Many daily rainfall records were set across the region from the 17th through the 22nd. Some noteworthy records include the following:

On the 18th, daily rainfall records included 3.19 inches at Santa Maria airport and 2.80 at Santa Barbara airport, both of which also set new records for any day during any month of December.

On the 19th, daily rainfall records included 2.80 inches at downtown Los Angeles, which was its 8th wettest December day ever. At Santa Barbara airport, the total of 2.79 inches set a new daily record. It was also its 2nd wettest December day ever, the wettest having been set the previous day. The daily total of 2.07 inches at Long Beach airport set a new record for the day, and was its 3rd wettest December day ever. At Los Angeles airport, the daily total of 2.23 inches set a new daily record, and was the 4th wettest December day ever.

On the 20th, a new daily rainfall record was set at Long Beach airport with 2.03 inches, its 4th wettest December day ever.

(Continued on Page 2)

Office Comings and Goings

By Joe Sirard

Meteorologist Intern Jamie Meier left her position at WFO Los Angeles/Oxnard in mid February. Although we are saddened to see her go, she is leaving for a great reason - a promotion to a Hydrologic Forecaster position at the California-Nevada River Forecast Center in Sacramento! For Jamie it will be a return to familiar surroundings as she attended UC Davis for 4 years and was also a student intern at the Sacramento NWS office. We wish Jamie and her husband all the best for a terrific future!

In her place we welcome meteorologist Carol Smith who's last duty station was Eureka, CA. She is due to arrive in July.

Super Soggy December (cont.)

(Continued from page 1)

The week long siege of rain brought periods of flooding to the region, along with some mud and debris flows and rock slides, the most serious of which occurred on the 22nd. Significant flooding of the transition road between interstate 10 and highway 57 was reported during the early morning of the 22nd, with a large amount of water in lanes and mud coming down from the hill sides. A small mountain side collapsed onto Little Tujunga canyon road at Sand Canyon Highway during the late morning hours, and rocks and debris covered all lanes at one point. During the afternoon hours of the 22nd, all lanes of Big Rock Creek Road in the Antelope Valley were covered by flooding and debris, and mud and heavy flooding was reported on an onramp to the 10 Freeway east of downtown Los Angeles. Three cars were trapped in flood waters on Avenue H east of Lancaster during the early afternoon hours, and five people had to be rescued. A funnel cloud was reported near the San Pedro area at 240 pm on the 22nd.

Highway 1 is flooded under a railroad bridge just north Guadalupe on Dec. 19, 2010. [Raiza Canelon/Santa Maria Times]

Rainfall totals for the week long storm were impressive, averaging 5 to 10 inches in coastal and valley areas...and 10 to 18 inches in the foothills and mountains, with local totals as high as 24 inches in the San Gabriel Mountains and the mountains of western Ventura County.

After a couple of dry days, another front swept through the region late on the 25th and into the 26th. The front brought rainfall totals of one half inch to one inch in most areas with locally higher totals, especially in the foothills.

The final weather system of the month swept through the region late on the 28th and 29th. Rainfall for this system ranged from 0.75 inches to 1.50 inches north of Point Conception, and between 0.50 and 1.00 inches south of Point Conception, with locally higher amounts in the foothills.

In downtown Los Angeles, the 10.23 inches of rainfall received in December was the second most in any December since records began in 1877. It also made December 2010 the 14th wettest of any month in history at the site. Rainfall in December 2010 was equal to nearly 70% (67.5%) of the entire seasonal normal for downtown Los Angeles, which is 15.14 inches.

The following table shows rainfall totals for selected stations for December 2010 (in inches); normal rainfall for the month of December; percent of normal rainfall; the wettest previous December; and where December 2010 ranked at that station in terms of rainfall.

	Dec 2010 Rain	Dec Normal	Percent of Norm	Wettest Dec	Dec 2010 Ranking
Downtown Los Angeles.....	10.23	1.91	536%	15.80/1889	2nd
Los Angeles Airport.....	8.83	1.79	493%	6.49/2004	1st
Long beach airport.....	10.41	1.76	591%	5.29/1971	1st
Burbank airport.....	8.36	2.15	389%	8.07/1940	1st
Woodland Hills.....	6.37	2.38	268%	8.44/2004	5th
Lancaster Airport.....	3.96	1.01	392%	5.35/1984	3rd
Sandberg.....	4.83	2.17	223%	10.26/1971	8th
Camarillo Airport.....	7.21	2.11	342%	5.32/1964	1st
Oxnard (NWS).....	9.16	2.11	434%	6.25/1997	1st
Santa Barbara Airport.....	10.36	2.26	458%	6.78/1945	1st
Santa Maria Airport.....	9.82	1.84	534%	7.50/1941	1st

For more on Flooding and Flash Flood safety, please check out:

http://www.floodsafety.noaa.gov/

Atmospheric River Deluge

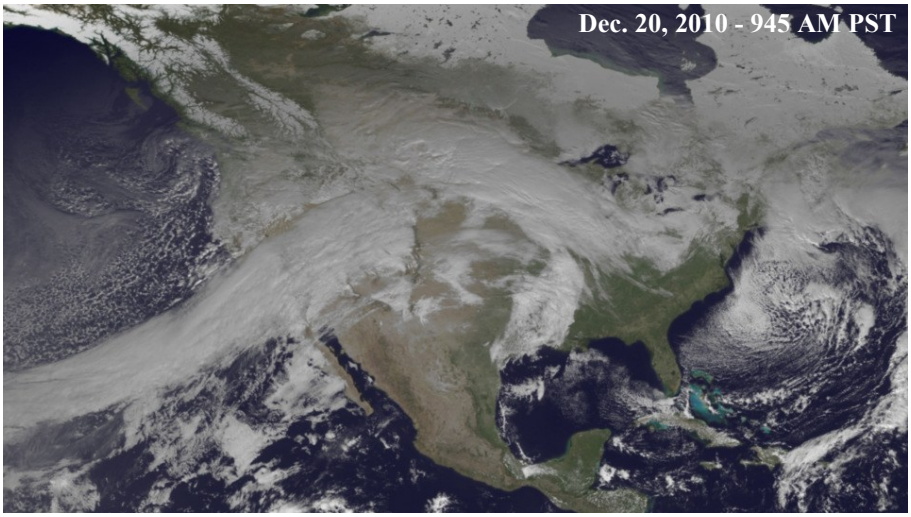
by Eric Boldt

A relatively dry December 2010 changed dramatically starting on the 17th as a blocking high pressure system over the eastern Pacific Ocean retrograded westward allowing low pressure to dominate off the west coast. This low pressure system soon tapped into a deep moisture source originating west of Hawaii and undercut the high pressure system to the north. Even a tropical storm briefly formed in the main low pressure region west of Hawaii.

The long conveyor belt of moist, subtropical air (a.k.a., atmospheric river) languished over southern California for more than 100 straight hours breaking daily and monthly all-time precipitation records in many areas (see Super Soggy December, page 1).

Most valleys and coastal areas received from 5-10 inches of rain during the period, with foothill and mountain areas recording from 15-25 inches.

Snow levels remained fairly high throughout the majority of the precipitation event (above 7000 feet) until the final day on December 22nd when colder and more unstable air moved over the region behind a cold front.



Precipitation totals were the highest for a single storm event in the last 5-10 years. However, no major flood problems were reported in southwestern California (San Luis Obispo, Santa Barbara, Ventura, and Los Angeles Counties). Even so, the Sisquoc River made a significant jump above monitor stage on Dec. 19 when higher intensity rainfall of 3-5" in 24-hours occurred across Santa Barbara and San Luis Obispo Counties.

There was also flooding in low-lying areas and along Arroyo Grande Creek during the event which caused the evacuation of several homes near the Oceano airport (San Luis Obispo Co). The Santa Maria River overflowed dikes and lead to minor damage to buildings in Santa Maria (Public Health Dept) and high water across roads in the Guadalupe area.

On Dec. 21st and 22nd, heavy rain over the San Gabriel Mountains drained across the desert and filled normally dry arroyos that impacted roads and highways with low-water crossings. Several cars were stranded along Avenue H to the east of Lancaster on Dec. 22nd, with 5 individuals and 1 dog rescued.

In a few locations along the PCH in the Santa Monica Mountain Recreational Area, rock slides blocked the highway which caused a shutdown of the freeway for several days.

There was one significant rock and mud slide near some homes in the West Hollywood Hills during the rain event, but no significant damage was reported.

In the recent burn areas (Station, Morris, Crown, Jesusita), no major problems were experienced from debris flows or flash flooding. LA County DPW reported that many debris basins were filled only 20-25% of capacity by the end of the rain event. A mandatory evacuation order was in place for 232 residents of La Canada Flintridge and La Crescenta on Dec. 21-22.

And finally on Dec. 22nd, following a 1-2 hour period of heavy rainfall, a small pop-out landslide occurred in La Conchita. A tear in the hillside about 100' high by 120' wide occurred and came within 10 feet of the back of one house. There was no damage except some trees were knocked over and 3 homes were evacuated.

La Niña and its Affects on Southern California Weather by Sean Klein

La Niña, like its sibling El Niño, occurs about every 3-7 years. While El Niño results in above average Sea Surface Temperatures along the Equator in the Central and Eastern Pacific Ocean, La Niña results in below average Sea Surface Temperatures in roughly the same region. Both variations of ENSO (El Niño Southern Oscillation: essentially the seesaw that occurs between El Niño and La Niña) result in changes in global weather patterns, but unlike El Niño, La Niña gets very little attention from media in Southern California. This lack of La Niña coverage is well founded. While El Niño increases the potential for damaging winter-time storms in Southern California, La Niña often results in less frequent and weaker winter-time storms. These effects combined with slightly below average air temperatures make La Niña benign, somewhat predictable, and on the whole: a rather lackluster news story. Issues of excitement aside, the remarkable consistency of southern California rainfall during La Niña makes the cold ENSO sister extremely interesting from a meteorological standpoint.

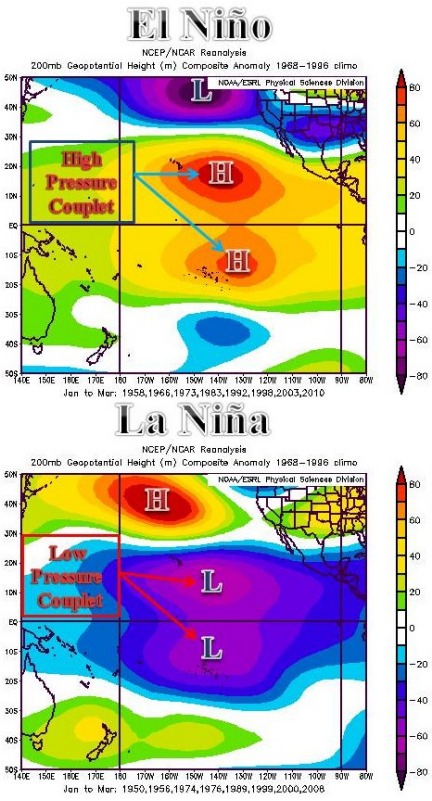


Fig. 1 High and low pressure couplets formed during Jan-Mar of El Niño/La Niña years

During an El Niño, unusually strong high pressure forms high in the atmosphere over the tropical Eastern Pacific in response to low pressure near the ground (because the ocean is warmer, the air above it is warmer. Warmer air is less dense, hence lower air pressure). Not surprisingly, the opposite occurs during La Niña where unusually weak low pressure forms high in the atmosphere over the tropical Eastern Pacific in response to high pressure near the ground (because the ocean is cooler, the air above it is cooler. Cooler air is more dense, hence higher air pressure) (**Fig. 1**). The pressure however does not change as intensely to continued ocean cooling during a La Niña event as it does to ocean warming during an El Niño. This suggests that the strength of an El Niño (weak, moderate, strong) has more of an effect on our weather than the strength of La Niña.

The significance of these pressure differences is their relation to the strength and position of the Pacific Jetstream. While these pressure changes themselves are not likely the cause of the repositioned Jet, they are representative of the pressure imbalance between the tropics and the poles. Higher pressure in the tropics means greater pressure difference between the equator and poles, lower pressure in the tropics means lower pressure difference between the equator and the poles. The stronger this pressure difference, the stronger the Jetstream. The Jetstream of course does not flow from south to north, but from west to east, and this is because of the spin of the Earth (Coriolis Force) (**Fig. 2**). Because the Jetstream occurs at the location of greatest north-south pressure difference, it will form at the intersection between the two most differing air masses. During El Niño, this location is in between the upper level high pressure discussed above and the Aleutian Low. During La Niña, this location is in between a Central Pacific High and the easterly repositioned Aleutian Low (**Fig. 3**).

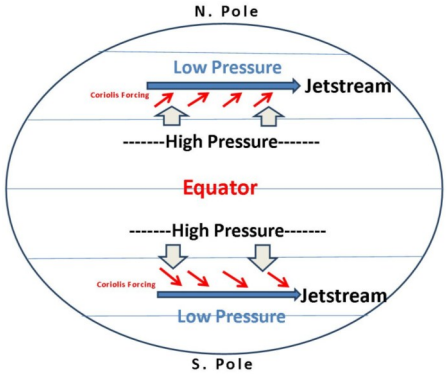


Fig. 2 A simplification of how the Jetstream is formed at the top of the Troposphere (lowest layer of atmosphere).

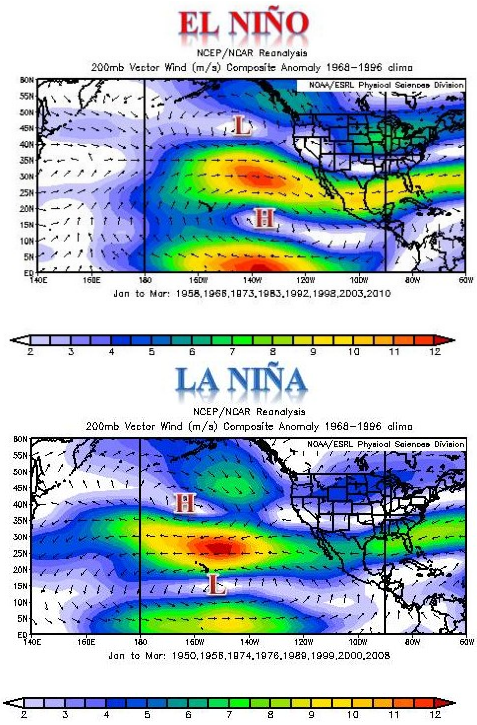


Fig 3. (Top) Vector Wind Anomaly (m/s) at 200mb during Jan through March for the 8 strongest El Niño events as measured by ONI. (Bottom) Vector Wind Anomaly (m/s) at 200mb for Jan through March for the 8 strongest La Niña events as measured by ONI.

The change in position of the Jetstream means colder, drier winters during La Niña, and warmer, wetter winters during El Niño. That said, the above statement is in reference to the average climate during an El Niño or La Niña. Various factors can cause the above statement to be untrue for any one particular El

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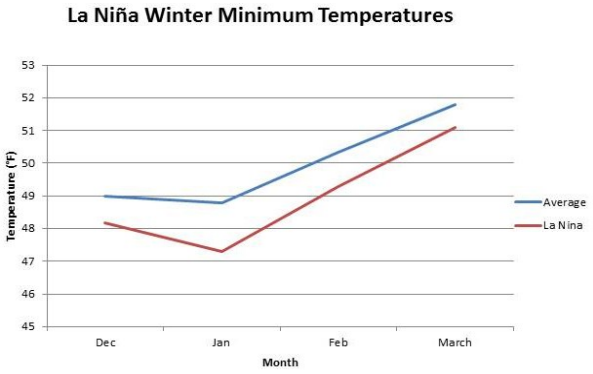
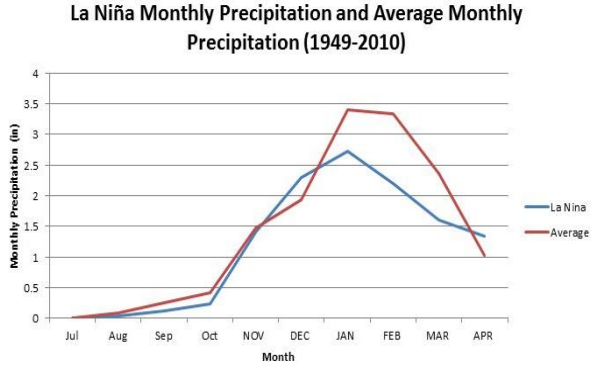
La Niña and its Affects on Southern California Weather (cont.)

(Continued from page 4)

Niño or La Niña event. Furthermore, these changes are usually confined to the winter months (January through March). For example: during the fall months (Oct-Dec) of La Niña, downtown Los Angeles on average receives 103% of normal precipitation (Just about average). Just under half of La Niña's (43%) produced above average precipitation during the same (Oct-Dec) time frame. This is followed by a sharp drop off in precipitation (as a percent of average) during the winter months, (January, February, March) where La Niña Precipitation drops to just 72% of normal. La Niña's effect on precipitation follows the same trend as El Niño's effect on precipitation where strong differences from normal precipitation do not occur until the winter months.





Similarly, average minimum temperatures during a La Niña (Dec-March) tend to be slightly below average: ranging from about ¾ of a degree below normal during November and March to 1.5 degrees below average during January (**Fig. 4**). This is likely the result of less latent heating (condensation warms the air) due to less rain days. Not only are there (as one would expect) fewer days with precipitation during La Niña, but there are also less days with high precipitation amounts. During February for example, the rate of occurrence of 1 in. or greater precipitation days is more than 3 times higher during an El Niño than during a La Niña. (2.06 times/month vs. 0.6 times/month).

All in all, La Niña (on average) whether weak or strong, results in slightly cooler winter temperatures, near average fall precipitation and below average (though not significantly below average) precipitation from January through March. Precipitation and temperatures vary from one La Niña to the next, but the majority of La Niña years (52%) have produced seasonal totals (Nov-Apr) between 8.7 in. and 13.7 in for the CQT, providing moderate confidence in winter/spring precipitation totals.

To find out more about La Niña and El Niño, check out NOAA's El Niño web site at www.elnino.noaa.gov

From Your Spotter Coordinator, Joe Sirard

Hello Storm Spotters! Wow, has it ever been an active winter and early spring across Southern California! I want to thank each and every one of you for your dedication in reporting hazardous and even severe weather conditions to the NWS office in Oxnard over this past rainy season. I also want to welcome all the new storm spotters (over 170) that have joined the southwestern California Storm Spotter Network since last August. Your participation in the Network is a critical element to what we do here at the NWS: issuing warnings for the protection of lives and property.

As you can see from reading through this edition of *Weather or Not?*, copious amounts of rain had fallen on the area during December, specifically during a 6-day deluge from December 17th through the 22nd. Additional significant rain and mountain snow occurred from late February through March, bringing seasonal rainfall totals to well above normal across the region. In fact, there has been so much rain and mountain snow across California this past rainy season that the statewide drought was lifted by Governor Brown on March 30th, 2011. Even so, we all need to continue to do our part and conserve water for the dry years.

I hope you enjoyed this edition of *Weather or Not?* Until next time, have a great summer everyone!

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This Spotter Newsletter is issued as part of the SKYWARN Storm Spotter Program at the Los Angeles/Oxnard National Weather Service Office.

If you are interested in becoming a volunteer Storm Spotter, please access the online training materials at http://www.wrh.noaa.gov/lox/spotter/course/

After reviewing the training slides you will need to take a short quiz. Following the training you will be an official SKYWARN Storm Spotter!

New spotters will receive a packet of information including our Storm Spotter Pocket Guide and a Spotter ID Badge.

Thanks for your interest in the Spotter Program!

What to Report?

Remember to please keep calls short with the information given below, as well as specific times and locations of reports, and a reference to the nearest city/town (if possible). There are many spotters who call at the same time. This helps all calls get through in a timely manner.

Flooding/Debris Flows:
- Rainfall Intensity: How much is falling over a specific period?
- Flooding or Debris Flows that are threatening life/property, or are disrupting traffic.
- Describe the flooding:
  - water depth
  - time it began and ended

Winter Weather:
- Amount, rate and time of new snow accumulations.
- Elevation of snow level
- Icing of roads or road closures
- Very low temperatures:
  - Coast: 35 degrees or lower
  - Valleys: 30 degrees or lower
  - Deserts: 20 degrees or lower
- Significant wind chill

Fog:
- Report visibilities less than or equal to 1/4 mile

Wind:
- Report winds of 30 mph or more
- Speed of winds (sustained or gusts)

Extreme Heat:
- Report for these temperature thresholds:
  - Coast: 95 degrees or higher
  - Valleys: 105 degrees or higher
  - Deserts: 115 degrees or higher

Thunderstorms:
- Estimated location, duration, speed and direction of movement
- Any hail (size, accumulation, etc)
  - 1/4" = pea size
  - 1/2" = marble size
  - 3/4" = penny size
  - 1" = quarter size
  - 1 3/4" = golf ball size
- Wind speeds and gusts
- Rainfall rate and amount
- If lightning strikes any object

Surf:
- Report when surf is 6 feet or greater
- Any flooding or damage caused by high tides and/or high surf

Tornadoes:
- Funnel clouds, waterspouts or any rotating clouds
- Estimated location, duration, speed and direction or movement

Damage or Injuries:
- Please report any confirmed weather-related damage, injuries, or deaths.